

REMARKS

Grounds of Rejections

Claims 1-8, 14-17 and 62-64 have been rejected under 35 USC §112, first paragraph, as failing to comply with the written description requirement.

Claims 1, 4, 5, 14-17 and 62-64 have been rejected under 35 USC 103(a) as being unpatentable over Yew et al. (US Patent No. 6,137,164).

Claims 1, 4, 5, 14-17 and 62-64 have been rejected under 35 USC 103(a) as being unpatentable over Yew et al. as applied to claims 1, 4, 5, 14-17 and 62-64 supra, and further in combination with Yoneda et al. (US Publication No. 2003-0006503).

Claim 2 has been rejected under 35 USC 103(a) as being unpatentable over Yew et al. or Yew et al. and Yoneda et al. as applied to claim 1 supra, and further in combination with Hanaoka et al. (US Publication No. 20020030245).

Claims 9-12 and 58-61 have been rejected under 35 USC 103(a) as being unpatentable over Yew et al. (US Patent No. 6,137,164) and further in combination with Hanaoka et al. (US Publication No. 20020030245).

Claim 12 has been rejected under 35 USC §102(a) as being unpatentable over Yew et al. (US Patent No. 6,137,164) and Hanaoka et al., and further in combination with Yoneda et al. (US Publication No. 2003-0006503).

Claims 9-11 and 13 have been rejected under 35 USC 103(a) as being unpatentable over Hanaoka et al. (US Patent Publication No. 20020030245).

Claim 12 has been rejected under 35 USC §103(a) as being unpatentable over Hanaoka et al. (US Publication No. 20020030245).

Claim 12 has been rejected under 35 USC 103(a) as being unpatentable over Hanaoka et al. (US Patent Publication No. 20020030245), and further in combination with Yoneda et al. (US Patent Publication No. 20030006503).

The rejections under 35 USC §103(a) are traversed for the reasons to follow.

Summary Of Claimed Subject Matter

Claims 1-18 are directed to a semiconductor package 50 (Figure 2A). Claims 58-64 are directed to an assembly 130 (Figure 8A) that includes the package 50 (Figure 2A).

The package 50 (Figure 2A) includes a substrate 54, a semiconductor die 52 mounted to the substrate 54, and an encapsulant 48 molded to the substrate 54 encapsulating the die 52. The substrate 54 includes die contacts 86 that are placed in electrical communication with bond pads 60 on the die 52. The substrate 54 also includes conductors 72 (Figure 2B) and bonding sites 66 in electrical communication with the die contacts 86.

The package 50 (Figure 2A) also includes external contacts 84 on the bonding sites 66 arranged in a dense array, and configured as input/output ports for the package 50. The external contacts 84 comprise multi layered metal bumps that include a base layer 88 (first layer) on the bonding sites 66, a bump layer 90 (second layer) on the base layer 88, and an outer layer 92 (third layer) on the bump layer 90. The base layer 88 comprises a metal such as copper, that adheres to the bonding sites 66, which can also comprise copper. The bump layer 90 comprises a metal such as nickel, that can be easily deposited to a desired thickness on the base layer 88. The outer layer 92

comprises a non-oxidizing metal, such as gold, that will bond easily to mating electrodes 136 (Figure 8B) on a supporting substrate 132 (Figure 8B).

In addition to the external contacts 84 comprising multi layered metal bumps, the die contacts 86 also comprise multi layered metal bumps having substantially the same configuration. This configuration allows the die 52 to be more easily flip chip bonded than with conventional solder balls or balls (i.e., C4 process). In addition, a thickness of the package 50 and a planarity of the package 50 on a supporting substrate 132 (Figure 8B) are improved.

Argument

35 USC §112, First Paragraph, Rejections Of Claims 1-8, 14-17 And 62-64

Claims 1-8, 14-17 and 62-64 have been rejected under 35 USC §112, first paragraph, because the recitation "about 0.1 mm to 1.44 mm" does not have antecedent basis in the specification for "about". In response to these rejections, the recitation "about 0.1 mm to 1.44 mm" has been removed from claims 1, 14 and 62.

35 USC §103(a) Rejections Of Claims 1, 4, 5, 14-17 And 62-64 Over Yew et al.

These 35 USC §103(a) rejections are traversed, as neither Yew et al., or the incorporated reference Abbott et al., disclose or suggest all of the features of the present claims, as required by MPEP 2142, 2143. However, independent claims 1, 14 and 62 have been amended to include additional recitations which are not disclosed or suggested by the cited art.

In particular, independent claims 1, 14 and 62 have been amended to recite the feature of die contacts 86 (Figure 2A) with first planar tip portions 87 (Figure 2D), in combination with external contacts 84 (Figure 2A) with second planar tip portions 85 (Figure 2C). Independent

claims 1, 14 and 62 have also been amended to recite the feature of the external contacts being configured to reduce the height of the package and to improve the planarity of the package. This combination of features provides an unobvious result in that the package has a reduced thickness and an improved planarity.

Claim 1 recites "each external contact comprising a multi layered metal bump including a first metal layer on a bonding site, a second metal layer on the first metal layer, and a non-oxidizing outer layer on the second metal layer". In Yew et al. the external contacts for the package are in the form of solder balls 440 (Figure 4A). As discussed in the "Background of the Invention" of the present specification, conventional solder balls make a package thicker, larger and non-planar. Yew et al. thus teaches away from the presently claimed external contacts having second planar tip portions and a reduced height.

Abbott et al., which is incorporated by reference into Yew et al., discloses multi layered solder balls 800 (Figure 6a). However, in the discussion on the polymer bumps 115 (Figure 3), at column 6, lines 32-34, Abbott et al. teaches away from bumps having planar tip portions and a reduced height. Under the case law a reference that teaches away from a claimed feature does not properly anticipate the feature.

Claim 1 has also been amended to recite "a plurality of external contacts on the second side having a plurality of second planar tip portions configured to facilitate bonding to mating electrodes on a second substrate and to insure a planarity of the package on the second substrate". The planar tip portions 85 are shown in Figure 2C. In addition, antecedent basis for the "bonding" and "planarity" recitations is contained on page 7, lines 4-9 of the specification, and on page 5, lines 7-10 of the specification.

Amended independent claims 14 and 62 also include recitations on the planar tip portions 87 (Figure 2D) of the die contacts 86 (Figure 2A), and the planar tip portions 85 (Figure 2C) of the external contacts 84 (Figure 2A). In addition, independent claims 14 and 62 include recitations on bonding the external contacts to a supporting substrate 132 (Figure 8B), and on the planarity of the package on the supporting substrate.

In view of these features recited in amended independent claims 1, 14 and 62, the rejected claims are submitted to be unobvious over Yew et al.

35 USC §103(a) Rejections Of Claims 1, 4, 5, 14-17 And 62-64 Over Yew et al. and Yoneda et al.

With respect to these 35 USC §103(a) rejections, the arguments stated above with respect to independent claims 1, 14 and 16 having features not disclosed by Yew et al. and Abbott et al. are restated.

Yoneda et al. was cited as teaching at paragraph 470 "that external contact height and package thickness are result effective variables". In particular, Yoneda et al. states at paragraph 470 that the bumps 342 in Figure 135 reduce the height of the semiconductor device 310E and provide a thinner package. However, the bumps 342 (Figure 135) in Yoneda et al. correspond to the presently claimed die contacts 86 (Figure 2A), rather than the external contacts 84 (Figure 2A). The height reduction recitations of the present claims are based on the configuration of the external contacts 84 (Figure 2A), and are in combination with increased planarity recitations. One skilled in the art at the time of the present invention would not read Yoneda et al. and recognize that both height and planarity of a package could be unobviously improved by external contacts having a reduced height and planar tip portions.

In addition, the present external contacts are recited in combination with die contacts having planar tip portions.

In view of these features recited in amended independent claims 1, 14 and 62, the rejected claims are submitted to be unobvious over Yew et al. and Yoneda et al.

35 USC §103(a) Rejection Of Claim 2 Over Yew et al., Or Yew et al. And Yoneda et al., And Hanaoka et al.

With respect to this 35 USC §103(a) rejection of dependent claim 2, the arguments stated above with respect to independent claim 1 having features not disclosed by Yew et al., or Yew et al. and Yoneda et al. are restated.

Hanaoka et al. was cited as teaching "external contacts 14 generally pyramidal in shape with planar tip portions". However, Hanaoka et al. also teaches placing external terminals 24 (Figure 2) in the form of solder balls on the connecting portion 14 (paragraph 0132). The solder balls in Hanaoka et al. would increase the height of the package and decrease the planarity. One skilled in the art at the time of the invention would thus not read Hanaoka et al. and recognize that both height and planarity of a package could be unobviously improved by external contacts having a pyramidal shape with planar tip portions. In addition, the present external contacts are recited in combination with die contacts having planar tip portions.

In view of these features recited in amended claims 1 and 2, claim 2 is submitted to be unobvious over Yew et al., Yoneda et al. and Hanaoka et al.

35 USC §103(a) Rejections Of Claims 9-12 And 58-61 Over Yew et al. And Hanaoka et al.

With respect to these 35 USC §103(a) rejections, both independent claims 9 and 58 have been amended to include recitations which further distinguish the claims from the combination of Yew et al. and Hanaoka et al. In

particular, independent claim 9 has been amended to recite "the die contacts and the external contacts sized and shaped to reduce a thickness of the package, to facilitate bonding of the die contacts to the pads, to facilitate bonding of the external contacts to a second substrate, and to insure a planarity of the package on the second substrate."

Amended independent claim 58 recites die contacts having first planar tip portions in combination with external contacts having second planar tip portions. Independent claim 58 also recites that the external contacts are configured "to reduce a thickness of the package, and to insure a planarity of the package on the supporting substrate".

As argued above, die contacts and external contacts in combination having the stated characteristics and configuration are not disclosed by Yew et al. and Hanaoka et al. Amended claims 9-12 and 58-61 are thus submitted to be unobvious over Yew et al. and Hanaoka et al.

35 USC §103(a) Rejection Of Claim 12 Over Yew et al. And Hanaoka et al. and Yoneda et al.

With respect to this 35 USC §103(a) rejection of claim 12, amended independent claim 9 includes the above noted recitations that are not disclosed or suggested by the combination of Yew et al., and Hanaoka et al., and Yoneda et al. Claim 12 is thus submitted to be unobvious over Yew et al., Hanaoka et al., and Yoneda et al.

35 USC §103(a) Rejections Of Claims 9-11 And 13 Over Hanaoka et al.

With respect to these 35 USC §103(a) rejections, amended independent claim 9 includes the above noted recitations that are not disclosed or suggested by Hanaoka et al. Amended claims 9-11 and 13 are thus submitted to be unobvious over Hanaoka et al.

35 USC §103(a) Rejection Of Claim 12 Over Hanaoka et al.

With respect to this 35 USC §103(a) rejection of claim 12, amended independent claim 9 includes the above noted recitations that are not disclosed or suggested by Hanaoka et al. Claim 12 is thus submitted to be unobvious over Hanaoka et al.


35 USC §103(a) Rejection Of Claim 12 Over Hanaoka et al. and Yoneda et al.

With respect to this 35 USC §103(a) rejection of claim 12, amended independent claim 9 includes the above noted recitations that are not disclosed or suggested by the combination of Hanaoka et al., and Yoneda et al. Claim 12 is thus submitted to be unobvious over Hanaoka et al., and Yoneda et al.

Conclusion

In view of the amendments and arguments, favorable consideration and allowance of claims 1, 2, 4, 9-17 and 58-64 is requested. In addition, rejoinder of withdrawn dependent claims 3 and 6-8 is requested. In addition, an IDS is being filed concurrently with this Amendment. Should any issues remain, the Examiner is requested to contact the undersigned by telephone.

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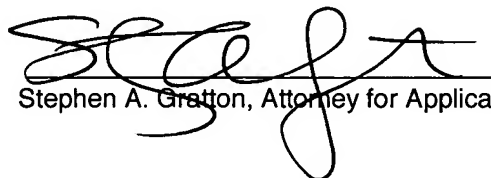
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